

UNITED STATES PATENT APPLICATION FOR:

ELECTROCHEMICAL CELL PLATE WITH INTEGRAL SEALS

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ELECTROCHEMICAL CELL PLATE WITH INTEGRAL SEALS

This application claims priority to U.S. Provisional Patent Application number 60/431,008 filed on December 4, 2002.

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to electrochemical cell components that form a seal with an adjacent component, a method of forming a seal between adjacent electrochemical cell components, and an electrochemical cell stack that is sealed.

Description of Related Art

Electrochemical cells generally employ a membrane electrode assembly ("MEA") consisting of a solid polymer electrolyte or ion exchange membrane disposed between two electrode layers, which are the anode and the cathode. An electrocatalyst is disposed at each membrane/electrode layer interface to induce the desired electrochemical reaction. The location of the electrocatalyst generally defines the electrochemically active area of the MEA.

In typical fuel cells, the MEA is supported on either side by layers of screen or expanded metal (flow fields) which in turn are surrounded by cell frames and separator plates (bipolar plates) to form reaction chambers and to seal fluids therein. The cell frames have at least one flow passage, and many times several flow passages formed therein to direct the reactant fluid streams to the respective electrode layers. For example, in a fuel cell the fuel is directed to the anode side and the oxidant is directed to the cathode side. In a single cell arrangement, cell frames, flow fields and end plates are provided on each of the anode and cathode sides of the MEA. The end plates act as current collectors and provide support for the electrodes.

Two or more fuel cells or other types of electrochemical cells can be connected together to form a bipolar electrochemical cell stack. In these bipolar arrangements, one side of a given bipolar plate communicates with an anode for one cell and the other side of the bipolar plate communicates with the cathode for an adjacent cell. The stack typically includes inlet ports and manifolds for directing the reactant fluids to the anode

and cathode flow field passages respectively. The stack often also includes an inlet port and manifold for directing a coolant fluid to interior passages within the stack to absorb heat generated by the exothermic reaction in the cells. The stack also generally includes exhaust manifolds and outlet ports for expelling the reactant fluids, any water or other products formed as a result of the reaction, as well as an exhaust manifold and outlet port for the coolant stream exiting the stack.

Within the stack, the individual cell frames typically contain multiple ports for the passage of reactant fluids and perhaps also cooling fluids. A common method for providing a fluid communication pathway between the electrode or active area of a cell and individual fluid manifolds in the frame comprises channels machined into the cell frame. The channels typically comprise grooves cut into the face of the cell frames. Fluids, after passing through the inlet manifolds and the channels, enter the flow fields to make contact with the electrode, and membrane. The fluids and gas products similarly exit through opposing channels in communication with the outlet manifolds.

Traditionally gaskets and o-rings have been used in the assembly or electrochemical cells and cell stacks to provide the fluid seals required to contain the fluids within various compartments of the electrochemical cells or cell stacks. A sealing surface is a compressible material that is placed between two typically non-compressible surfaces to form a fluid-tight joint. Sealing surfaces are often gaskets and o-rings that are manufactured in a large number of sizes and shapes to provide the compressible material required to form fluid-tight joints in a wide variety of applications.

The cell frames are usually sealed by means of sealing ridges that are embossed, machined, or molded into the frame. The sealing features react against gaskets included in the stack to maintain fluid tight joints and also grip the gaskets to prevent creep and extrusion of the gasket. The compression of the fuel cell stack applies the sealing force to the fluid tight resilient seals between the various components, including frames, separator plates and membranes. Such seals typically circumscribe the manifolds and the electrochemically active area on the cell frame.

Another drawback of existing cell frames is the method used to make a fluid-tight seal between the frames in a stack. Molter, *et al.* discloses a typical electrochemical cell

frame in U.S. Patent No. 6,099,716 that provides ridges on the frame's sealing surfaces with gaskets between these surfaces. Upon assembly, Molter discloses that the gaskets may be glued to the sealing surfaces to keep the gaskets in place during assembly. Because of the manifolds running through the cell frames, the gaskets are often very complex or numerous to provide all the sealing surfaces required.

Accordingly, there remains a need for improved leak-proof seals for use between electrochemical cell components, such as between the frame and the bipolar plate. It would be desirable if the seals were easier to assembly and could be integrated into other components to reduce part count.

SUMMARY OF THE PRESENT INVENTION

The present invention provides an electrochemical cell component having a plate with first and second opposing faces, a first seal groove formed in the first face, a second seal groove formed in the second face, and a plurality of holes extending through the plate between the first groove and the second groove and an integral sealing member formed in the grooves and holes. Preferably, the integral sealing member is formed by injection molding and the plate is made of a metal or polymer.

The seal grooves extend continuously around the perimeter of the faces and the grooves may have any cross-sectional shape and may follow any type of contiguous pattern, such as, for example, a curvilinear path, a straight path or combinations thereof. The plate may have any shape, including circular, ovoid, oval, polygonal and elliptical.

There is also at least one flow channel formed in the first face of the plate from a fluid inlet manifold to an inner edge of the plate and at least one flow channel formed in the first face of the plate from the inner edge of the plate to a fluid outlet manifold. The seal grooves isolate each manifold from all other manifolds and from leaking out of the cell.

If the plate is made of a polymer, preferred polymers include polyvinylidene fluoride, polyvinylidene difluoride, polytetrafluoroethylene, polyamides, polysulfone, polyetherketones, polycarbonate, polypropylene, polyimides, polyurethanes, epoxies,

silicones, and combinations thereof. The plate may be formed, for example, by injection molding or by being machined from a solid block of the polymer.

A central portion of the plate may be removed, such that the plate forms a frame that can receive other components, for example a flow field. Alternatively, the plate may be formed as a frame initially with a central portion sized to accommodate, for example, a flow field or a membrane and electrode assembly. The flow field is preferably made of a material selected from expanded metal mesh, metal screen, metal felt, metal foam and combinations thereof. Other electronically conductive materials may form the flow field as well.

Additionally, the present invention provides a bipolar plate assembly having a first and a second frame disposed on opposite sides of a gas barrier, wherein each of the first and second frames comprise first and second opposing faces, a first seal groove formed in the first face, a second seal groove formed in the second face, and a plurality of holes extending through the frame between the first groove and the second groove and an integral sealing member formed in the grooves and holes.

Preferably, the first and second frames are bonded to the gas barrier but they may be held in place with the compressive forces asserted on an electrochemical stack to hold the stack together, such as through a set of endplates. Preferably, the gas barrier is a metal sheet or other electrically conducting material.

The integral sealing member may be formed by injection molding. The seal grooves extend continuously around a perimeter of the faces, and may have any cross-sectional shape. The seal grooves may follow a contiguous pattern, such as, for example, a curvilinear path, a straight path or combinations thereof. The bipolar plate may have any shape, including circular, ovoid, oval, polygonal and elliptical.

The bipolar plate of the present invention further has at least one flow channel formed in the first face of the first frame from a first fluid inlet manifold to an inner edge of the first frame, at least one flow channel formed in the first face of the first frame from the inner edge of the first frame to a first fluid outlet manifold, at least one flow channel formed in the first face of the second frame from a second fluid inlet manifold to an inner

edge of the second frame, and at least one flow channel formed in the first face of the second frame from the inner edge of the second frame to a second fluid outlet manifold.

The seal grooves on each frame isolate each manifold from all other manifolds on each frame. The grooves encircle all manifolds formed through the faces of each frame except for the manifolds that are provided with the at least one flow channel

The frames may be made of any suitable material including, for example, metal and polymer. Acceptable polymers include polyvinylidene fluoride, polyvinylidene difluoride, polytetrafluoroethylene, polyamides, polysulfone, polyetherketones, polycarbonate, polypropylene, polyimides, polyurethanes, epoxies, silicones, and combinations thereof. The frames may be made by methods including injection molding and being machined from a block of solid polymer.

Flow fields are contained within the frames. The flow fields may be made of materials including expanded metal mesh, metal felt, metal foam and combinations thereof.

Another embodiment of the present invention includes a fluid cooled bipolar plate assembly having a first, a second, and a third frame, wherein each of the frames comprise first and second opposing faces, a first seal groove formed in the first face, a second seal groove formed in the second face, and a plurality of holes extending through the frame between the first groove and the second groove and an integral sealing member formed in the grooves and holes, a first gas barrier and a second gas barrier, wherein the first gas barrier is disposed between the first and second frames and the second gas barrier is disposed between the second and third frames, and a cooling flow field, wherein the second frame surrounds the cooling flow field.

Another embodiment of the present invention provides an electrochemical cell component having a plate having first and second opposing faces, a seal groove formed in the first face, a ridge formed in the second face, and a sealing material contained within the seal groove, wherein the second face opposes a membrane, and wherein the ridge forms a fluid-tight seal by compressing an opposing surface of the membrane. Bipolar plates and fluid cooled bipolar plates may also comprise this component.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a top view of a frame that may be used in an electrochemical cell or cell stack in accordance with the present invention.

FIG. 2 is a top view of the reverse side of the frame shown in FIG. 1.

FIGs. 3A and 3B are cross sectional side views of a component having an integral sealing member formed in a seal groove.

FIG. 4 is an exploded view of a bipolar plate in accordance with the present invention.

FIG. 5 is an exploded view of a fluid cooled bipolar plate in accordance with the present invention.

FIGs. 6A-C are cross-sectional views of an electrochemical component having a sealing groove formed on only one face in accordance with the present invention.

DETAILED DESCRIPTION OF THE INVENTION

The present invention provides an electrochemical cell component having an integral sealing member. The integral sealing member may be formed on one side or both sides of the component to replace at least one traditional gasket or o-ring that is provided between components during the assembly of an electrochemical cell or stack of cells. The present invention further provides a subassembly that includes at least one electrochemical cell component having an integral sealing member. Further still, the present invention provides an electrochemical cell stack including at least one component having an integral sealing member.

In order to form an integral sealing member, a seal groove is formed at the location where a sealing member is needed, such as where a gasket or o-ring would traditionally have been installed during the assembly of an electrochemical cell or cell stack. In order to form an integral sealing member on both sides of an electrochemical cell component, a seal groove is formed in both faces of the component. Preferably, the seal groove on one face of the component is in fluid communication with the seal groove

on the opposite face of the component via a plurality of vias or holes formed approximately in the center of the seal grooves and distributed along the length of the grooves. An integral sealing member is then formed in the seal groove and through the holes such that the sealing member in the groove on one face of the component is held in place by being an integral part, through the holes, with the sealing member in the groove on the opposite face of the component.

An integral sealing member is preferably formed by injection molding an elastomer into the groove or grooves provided in the component. Suitable elastomers may be selected from a vinylidene fluoride hexafluoro-propylene tetrafluoroethylene copolymer (such as Viton, a trademark of DuPont), silicone, ethylene-propylene diene elastomers (EPDM) and combinations thereof. Other suitable materials may include elastomer grade plastics, such as olefins, styrenes, and fluoroplastics. It should be recognized that the sealing member will typically be over molded so that the sealing member will extend outward beyond the surface of the component when the sealing member is not being compressed. The over molded portion of the sealing member may have any shape as determined by the invention mold, but may include, without limitation, rectangular, semicircular, triangular, and ribbed.

The overall shape of the components provided by the present invention are not limited but rather may take any shape required by the configuration of a particular electrochemical cell or cell stack. Normally the component will be substantially planar in one dimension and have a curvilinear shape in the other two dimensions, such as a plate, but the shape of the planar component may include, without limitation, circular, ovoid, oval, elliptical and polygonal.

The groove itself may have any cross-sectional shape including, without limitation, rectangular, semicircular, arches, triangular, other polygon, and irregular shape. Preferably, the groove is designed in a manner that the sealing member formed within the groove will be partially or completely physically restrained within the groove to prevent accidental displacement or improper positioning of the sealing member. By restraining the sealing member within the groove, the component becomes an integrated component. In embodiments that include a single groove, i.e., the component does not

include an opposing groove with vias therebetween, it is preferred for the cross-sectional shape of the groove to be wider at depth within the component than at the rim of the groove so that the sealing member formed within the groove will become physically restrained. In embodiments that have opposing grooves connected by vias, the sealing member is formed through the via and into the grooves and becomes restrained in position in that manner regardless of whether the cross-sectional shape of the groove is itself restraining. It should also be recognized that the sealing member may be restrained within the groove by adhesive bonding.

The component will have a groove that may follow a simple or complex continuous path or the component will have a plurality of grooves that may follow discontinuous paths. It is preferable that all the grooves be in fluid communication so that a single injection molding step can form the sealing member or members. This fluid communication can be provided by having a continuous groove, by providing vias between grooves, or by providing an injection mold that allows fluid communication therebetween. It should be recognized that grooves on opposing sides of the component may be the same or different. Furthermore, grooves on opposing sides may be restrained through the use of vias, through the use of inward widening cross-sectional shapes, or a combination thereof.

A conventional electrochemical cell stack comprises a plurality of membrane and electrode assemblies (MEA) that are each disposed between two flow fields to form one electrochemical cell, with each of these electrochemical cells separated by a bipolar plate. The flow fields ensure that the reactant fluids are well distributed across the face of the electrodes and they also act as electrical current collectors, transmitting electrons from the anode of a first cell to a bipolar plate and from the bipolar plate to the cathode of an adjacent cell. The flow fields are surrounded by frames. The MEAs are securely positioned between the flow fields. Reactant fluids are provided to the flow fields through manifolds that are formed in the manifold region of any component that extends into the manifold region, such as the frames, MEAs and bipolar plates. Flow channels are provided in the frames to direct the reactant fluids from an inlet manifold in the frame, across the flow field to an outlet manifold in the frame. Preferably, the sealing

surfaces between the frames and bipolar plates in the stack are arranged to provide fluid tight seals around the perimeters of the frames and bipolar plates and also around each individual fluid manifold in the frames and bipolar plates. While less preferred, it is also possible to incorporate the present invention into a component for an internally manifolded electrochemical cell.

One embodiment of the present invention is a frame for use in an electrochemical cell or cell stack. The frame may be made of any material, including metal, but is preferably an electrically nonconducting material, such as a polymer. Examples of polymers that are suitable for making an electrochemical cell plate include polyvinylidene fluoride, polyvinylidene difluoride, polytetrafluoroethylene, polyamides, polysulfone, polyetherketones, polycarbonate, polypropylene, polyimides, polyurethanes, epoxies, silicones, and combinations thereof. Frames made of polymer may be formed by injection molding or by machining the frame from a solid block of the polymer.

The frame is provided with inlet and outlet manifold holes for each of the fluids provided to the electrochemical cell stack. These fluids include the anodic reactant fluid, the cathodic reactant fluid and cooling or heating fluids, if required by the stack. The frame may surround other components of the electrochemical cell or stack such as a flow field or an MEA. One or more flow channels are formed in a first face of the frame from an inlet manifold to the inner edge of the frame. One or more flow channels are also formed in the same face from the inner edge of the frame to an outlet manifold. The flow channels allow a fluid to circulate from an inlet manifold to the flow field and from the flow field to an outlet manifold. If the fluid is totally consumed flowing across the electrode, an outlet manifold may not be required. It should be recognized that the sealing grooves should not interfere with the flow channels. While less preferred, the flow channels can also be provided as holes passing within the plane of the component from the manifold to the flowfield.

The second face or side of the frame may include flow channels, but in order to protect the delicate membrane of the MEA, the flow channels are preferably only provided in the face of the frame that faces the bipolar plate. Otherwise the sharp edges of the flow channels or the flow of the fluid through the channels to the flow fields may

damage the delicate membrane secured between opposing frames in an electrochemical cell.

The integral sealing member will normally extend around the entire circumference of the frame to seal the fluids into the electrochemical cell or cell stack. The integral sealing member will normally also extend around each of the manifold holes to provide a fluid tight seal that contains the fluids flowing through the manifolds. The sealing member will not extend totally around the manifolds that are open to a particular flow field through flow channels so that the fluid may flow between those particular manifolds and the flow field. Since the flow channels are preferably only formed on the face of the frame facing the bipolar plate, it is an option for the sealing member to totally encircle the manifold on the face without the flow channels.

The flow field may be bonded to the frame or the flow field may simply fit within the frame so that the flow field is surrounded by the frame but not bonded to the frame. The flow field may be made of a material selected from expanded metal mesh, metal felt, metal foam and combinations thereof.

The present invention also provides a bipolar plate for use in an electrochemical cell stack. The bipolar plate assembly comprises a first and second plate, as described above, disposed on opposite sides of a gas barrier. Optionally, the first and second frames may be bonded to the gas barrier to facilitate assembly of the electrochemical cell stack. The gas barrier is typically a metal sheet, but may also include a composite material providing water transport to the anode or cathode. Other materials known to those skilled in the art may be used to form the gas barrier as long as the materials are electrically conductive or an alternative electrical conductor is provided between cells.

The present invention further provides a fluid cooled bipolar plate for use in an electrochemical cell stack. The fluid cooled bipolar plate comprises first, second and third frames as described above, where the first and second frames are disposed on opposite sides of a first gas barrier and the second and third frames are disposed on opposite sides of a second gas barrier. The second frame surrounds a flow field for a cooling fluid. The cooling fluid circulates through the flow field from a cooling fluid supply manifold to a cooling fluid return manifold similar to the reactant fluid flow

described above. Alternatively, the fluid cooled bipolar plate may be used as a fluid heating bipolar plate if a heating fluid is circulated through the flow field rather than a cooling fluid.

Another embodiment of the present invention forms a sealing member on only one face of the electrochemical cell component. When assembling electrochemical cell stacks, membrane and electrode assemblies (MEA) are sandwiched between other components. The membrane itself may extend into the sealing areas of the electrochemical stack and act as a gasket or sealing member. The membrane of the MEA is a compressible material and therefore, when compressed between two rigid surfaces, the membrane creates a fluid tight seal. Therefore, if there is an MEA on one side of a component, such as a frame surrounding a flow field or a bipolar plate, the side of the frame or bipolar plate facing the MEA does not require an additional sealing member in order to form a fluid tight seal, because the membrane can serve that function. Membranes are conventionally made of perfluorosulfonic acids (PFSA) or other membranes known to those having ordinary skill in the art.

In designing electrochemical cell stacks that operate at high pressures, it is preferable to apply high localized compression of the sealing member rather than a lower compression across a larger interfacial area. Accordingly, the sealing members of the invention are preferably narrow and consume less than 20 percent of the face of the component. Where the sealing member is disposed over more than 20 percent of the facial area of a component, such as where the membrane extends between two components, then it is preferred to provide a ridge on the face of the component that pushes into the sealing member to form a fluid tight seal. The ridge pushes into the sealing member and forms a narrow but very fluid tight and pressure resistant seal. The ridge may be machined into the component face facing the membrane, or it may be formed in the frame if the frame is made in a mold, as by injection molding. Alternatively, the portion of the component underlying the seal groove may be made to bow outwardly and form a ridge under the force of the over-molded sealing member being compressed into the seal groove during assembly. If the component's thickness around the seal groove is sufficiently thin, compression of the component during

assembly creates a ridge from the sealing material pushing against the floor of the seal groove.

An advantage of using this embodiment in assembling an electrochemical cell stack is that there is a reduction in the total number of parts required to assemble the electrochemical cell stack. Additionally, the total weight of the electrochemical cell stack is less using this embodiment because the weight of further o-rings, gaskets or other sealing materials no longer contributes to the overall weight of the electrochemical cell stack. Furthermore, by removing these o-rings, gaskets or other sealing materials, the overall size, especially thickness, of the electrochemical cell stack is likewise reduced, resulting in a smaller electrochemical cell stack.

FIG. 1 is a top view of a preferred frame assembly that may be used in an electrochemical cell or cell stack in accordance with the present invention. The frame assembly is shown as circular, though any shape required by a particular electrochemical cell or cell stack would be satisfactory.

The frame 11 surrounds a flow field 14. Fluid flowing through the inlet manifold 18 enters the flow channels 15 formed in the face of the frame 11. The flow channels 15 direct the fluid to the inner edge 20 of the frame and into the flow field 14. The fluid flows across the flow field 14 and then to the flow channels 15 formed in the face of the frame 11 at the outlet manifold 19. Other manifolds are also formed in the frame 11. These manifolds include two other inlet manifolds 16, 22 and two other outlet manifolds 17, 21. These manifolds are not in fluid communication with the flow field 14 but are in fluid communication with other flow fields contained within the electrochemical cell stack. With three sets of manifolds, this type of frame may supply, for example, an anode reactant fluid to an anode flow field, a cathode reactant fluid to a cathode flow field and a cooling fluid to a cooling fluid flow field to form a fluid cooled bipolar plate. Fewer or more manifolds may be provided in the frames as required by a particular application.

A seal groove 13 is formed in the face around the circumference of the frame 11. The seal groove 13 is formed wherever a sealing surface is required to seal the fluids within the electrochemical cell or cell stack. The seal groove 13 also totally surrounds each of the manifolds 16, 17, 21, 22 that are not in fluid communication with the flow

field 14. The seal groove 13 does not totally surround the manifolds 18, 19 that are in fluid communication with the flow field 14, but only surrounds that portion of the manifolds 18, 19 that must have a fluid tight seal to prevent the fluids from leaking from the electrochemical cell or cell stack.

FIG. 2 is a top view of the reverse side of the frame shown in FIG. 1. The seal groove 13 is formed in the reverse side of the frame 11 at the same location as on the front side of the frame 11 as shown in FIG. 1. As on the front side of the frame 11, the seal groove 13 is formed wherever a sealing surface is required to seal the fluids within the electrochemical cell or cell stack. As on the front side of the frame 11, the seal groove does not totally surround the inlet and outlet manifolds 18, 19 that are in fluid communication with the flow field 14. Alternatively, the seal groove may totally surround these manifolds 18, 19 on the reverse side of the frame 11, if desired, because the fluid flow is directed through the flow channels 15 on the front side of the frame 11 as shown in FIG. 1. Alternatively, flow channels may also be provided, if desired, on the reverse side of the frame 11 for some or all manifolds in fluid communication with the flow field 14.

A plurality of holes 12 are formed through the frame 11 in the seal groove 13, preferably near the center of the groove. These holes 12 allow a sealing material that fills the seal grooves 13 to connect with and hold in place the sealing surfaces on each side of the frame 11. These sealing surfaces are thus an integral sealing member that is formed in the seal grooves 13 and holes 12 formed in the frame 11.

FIG. 3A is a cross sectional side view showing the integral sealing member 25 formed in the seal groove 13 of the frame 11 shown in FIGS. 1 and 2. The material forming the integral sealing member may be an elastomer or other suitable polymer and is preferably formed in the seal grooves 13 by injection molding. FIG. 3B is a cross-sectional side view of integral sealing members 26 formed on a single face of a component.

FIG. 4 is an exploded view of a bipolar plate in accordance with the present invention. The bipolar plate assembly 30 comprises two frames 11 disposed on opposite sides of a gas barrier 31. The frames 11 may be bonded to the gas barrier 31 using

adhesives, heat bonding or other means known to those skilled in the art or the frames may be compressed against the gas barrier without bonding. If the frames are bonded to the gas barrier, assembly of an electrochemical stack may be facilitated. The frames 11 are as described in FIGS. 1 and 2. The flow fields 14 are surrounded by the frames 11.

One side of the bipolar plate assembly 30 is the anode side 32 and the other side of the bipolar plate assembly 30 is the cathode side 33. The supply manifold 16 on the anode side 32 is provided with flow channels 15 on the side facing the gas barrier 31. Likewise, it may be seen that there are no flow channels on the inlet manifold 18 on the cathode side 33, since this figure shows the side of the cathode frame 11 facing away from the gas barrier 30. Flow fields 14 are provided and are surrounded by the frames 11. The flow fields 14 may be of different material and different construction from each other depending on the particular application. Furthermore, the flow fields may be used in communication with gas diffusion layers, current collector grids, and the like.

The integral sealing member 25 forms a fluid tight seal between the frames 11 and the gas barrier 31. It may be noted that there is no seal totally surrounding the supply manifold 18 in the frame 11 on the cathode side 33. Alternatively, a sealing member may be formed around this manifold 18 on the side of the frame 11 facing away from the gas barrier 31.

FIG. 5 is an exploded view of a fluid cooled bipolar plate in accordance with the present invention. The fluid cooled bipolar plate 40 comprises a flow field 41 that is provided with a cooling fluid circulating through the flow field 41 via a set of manifolds 22. The cooling flow field 41 is disposed between two gas barriers 31 forming the cooling section 42 of the fluid cooled bipolar plate 40. The anode side 32 is on one side of the cooling section 42 and the cathode side 33 is on the other side of the cooling section 42. It should be noted that a heating fluid may be substituted for the cooling fluid circulating through the cooling flow field 41 to add heat to the electrochemical cell if necessary.

FIGS. 6A-C are cross-sectional views of a component that forms a ridge on one face due to the compression of a sealing member in a sealing groove formed on the other face. In FIG. 6A, a component 60 has a seal groove 61 formed in the first face 65 of the

component 60. A sealing member 62 is contained within the seal groove 61. In FIG. 6B, the sealing member 62 is compressed, during assembly of the electrochemical cell stack, creating a ridge 63 in the second face 66 of the component 60. The ridge 63 forms a fluid tight seal by compressing the membrane (not shown) of a MEA during assembly. In FIG. 6C, an alternative component is shown having a ridge 64 permanently formed in the second face 66 of the component 60 during manufacturing of the component. The ridge 64 forms a fluid tight seal by compressing the membrane (not shown) of a MEA during assembly. It should be recognized that the permanent ridge does not have to directly oppose the seal groove and that any number, size or shape of ridges may be provided.

It will be understood from the foregoing description that various modifications and changes may be made in the preferred embodiment of the present invention without departing from its true spirit. It is intended that this description is for purposes of illustration only and should not be construed in a limiting sense. Only the language of the following claims should limit the scope of this invention.